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REMARKS

In the office action, the Examiner rejected claims 1, 2, 4-9, 11-13, 15-17, 19, 22-25, and 28 pursuant to 35 U.S.C. §102(e) as being anticipated by Skyba, et al. (U.S. Patent No. 6,692,438). Claims 3, 18, 20, 21, 26, 27, and 29-31 were rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Skyba, et al. in view of Hossack, et al. (U.S. Patent No. 6,755,787). Claims 30 and 31 were rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Skyba, et al. in view of Hossack, et al. and further in view of Sumanaweera, et al. (U.S. Patent No. 6,443,894). Claims 10, and 14 were rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Skyba, et al. in view of Chiang, et al. (U.S. Patent No. 6,969,352). Applicants respectfully request reconsideration of the rejections of claims 1-31, including independent claims 1, 16, 17, and 28.

Independent claim 1 recites identifying a phase of a cyclically varying imaging parameter relative to a physiological cycle for each of a plurality of spatial locations in each of a plurality of image frames, and highlighting spatial locations in a first image of the plurality of images associated with a first phase and spatial locations in a second image of the plurality of images associated with a second phase, the second phase different than the first phase and the second image corresponding to the different time than the first image.

Skyba, et al. does not disclose these limitations. Skyba, et al. generate a parametric image or images showing reperfusion of contrast agents (col. 2, lines 15-39). Ultrasound images are acquired at particular phases of the heart cycle (col. 3, lines 30-33; and col. 5, lines 21-33). Images associated with a same time relative to the heart cycle are grouped for forming a parametric image (col. 4, lines 37-43; col. 5, lines 33-41; and Figs. 5 and 6). Given images at one particular phase of the heart cycle (one group), an exponential curve is fitted to the image data for each spatial location (col. 6, lines 20-44). Figure 12 shows an example reperfusion (exponential) curve. The characteristics of the fitted curve are used to determine the image values for each location on the parametric image representing the specific phase of the heart cycle (col. 6, lines 45-59). A sequence of such parametric images

associated with different phases of the heart cycle may be generated (col. 6, line 60-col. 7, line 12).

Skyba, et al. identify the phase of the heart cycle for grouping images, not the phase of the cyclically varying imaging parameter relative to the heart cycle. Skyba, et al. fit an exponential curve to the data to identify perfusion over several heart cycles, so do not use a cyclically varying image parameter. Cyclical variation is removed by Skyba, et al. by grouping the images associated with a same phase of the heart cycle. Skyba, et al. do not determine any relative phase.

Independent claim 16 recites identifying a phase of a cyclically varying imaging parameter relative to a heart cycle for each of a plurality of spatial locations in each of a plurality of image frames. Accordingly, claim 16 is allowable for the same reasons as claim 1.

Independent claim 17 recites matching a sinusoid waveform with the ultrasound data for each of the pluralities of spatial locations. Skyba, et al. match an exponential representing perfusion of contrast agents, not a sinusoid waveform.

Claim 17 also recites isolating information associated at least one frequency band from information associated with a different frequency band for each of the plurality of spatial locations as a function of the matched sinusoid. Skyba, et al. filter to obtain fundamental or harmonic frequency information in the original image data (col. 3, line 54-col. 4, line 17). This process occurs well before the exponential curve is fitted to the data. Skyba, et al. do not disclose isolating information at one frequency as a function of the matched curve. Skyba, et al. also do not disclose adding information from the different frequency band to the isolated information.

Independent claim 28 recites matching a sinusoid waveform with the ultrasound data for each of the pluralities of spatial locations, and isolating information associated at least one frequency band from information associated with a different frequency band for each of

the plurality of spatial locations as a function of the matched sinusoid. As discussed above for claim 17, Skyba, et al do not disclose these limitations.

Dependent claims 2-15, 18-27, and 29-31 depend from the independent claims so are allowable for the same reasons as the corresponding base claim. Further limitations patentably distinguish from the cited references.

Claim 2 recites matching a sinusoid, and identifying a phase of the sinusoid relative to the time within the physiological cycle. Skyba, et al. use ECG information to select images for a heart cycle phase. The images are then used to match an exponential curve to the data. Skyba, et al. do not match a sinusoid, and do not identify a phase of the sinusoid relative to the time within the physiological cycle.

Claim 4 recites identifying the phase for single pixels. Skyba, et al. uses heart cycle phase for images, not single pixels. Skyba, et al. match the exponential using nine pixels for each image (col. 6, lines 21-24), not single pixels.

Claim 6 recites highlighting by setting the imaging parameter to a darker shade for spatial locations associated with the different phases. Skyba, et al. creates a parameter image, but does not suggest darker regions for spatial locations associated with a particular phase.

Claims 7 and 8 recite highlighting spatial locations associated with a range of phases. Skyba, et al. group images associated with specific phases (col. 5, lines 48-53), not a range of phases.

Claim 11 recites highlighting of one image associated with a first phase and free of highlighting for the second phase. Skyba, et al. generate a parameter image for each phase of the heart cycle. The parameter is used to create the image. Skyba, et al. does not disclose highlighting an already existing image.

Claim 23 recites generating images of intensities as a function of time responsive to adding information from a different frequency band to isolated information. Skyba, et al. generates images of intensities as a function of time to represent perfusion. The images are not generated responsive to adding information from a different frequency band to isolated information.

Claim 25 recites addition in the frequency domain. Skyba, et al. does not show the addition, and does not show any functions in the frequency domain.

Claims 3, 18, 20, 21, 26, 27, and 29-31 are allowable since a person of ordinary skill in the art would not have used the Fourier transform in Skyba, et al., especially as taught by Hossack, et al. Skyba, et al. use ECG signals to label the heart cycle phase associated with each image. There is no cyclical or frequency processing. Filtering is performed using transmit and receive techniques or FIR filtering. There is nothing in Skyba, et al. to suggest frequency domain processing and the corresponding use of a Fourier transform. Hossack, et al. teach Fourier transform for data compression. Data compression is unrelated to the teachings of Skyba, et al.

The Examiner alleges that once Fourier transform is performed, it is inherent that phase angle data and fundamental frequency would be known. However, Fourier transforms may be used for other purposes. Accordingly, phase angle data and fundamental frequency are not inherent. Regardless, there is no suggestion to use a Fourier transform in Skyba, et al.

Claims 3 and 18 recite matching a sinusoid by performing a Fourier transform. Hossack, et al. use the transform for compression, not matching a sinusoid.

Claim 20 recites isolating information associated with an unvarying component and a fundamental frequency component by reducing values for information associated with second harmonics. Hossack, et al. generally disclose a Fourier transform. The Fourier transform is used to avoid loss of information, so there is not suggestion to isolate fundamental component by reducing a second harmonic.

Claim 21 is allowable for a similar reason as claim 20.

Claims 27 and 29 recite transforming, isolating and inverse transforming the isolated information. Hossack, et al. teaches transforming an image while avoiding loss. Compression uses the relationship between pixels. There is no suggestion to transform data for a spatial location, and isolating frequency information associated with the spatial location.

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Claim 31 recites detecting a boundary from phase data. Skyba, et al. detects a boundary from image data, not phase data. Sumanaweera, et al. use Doppler data, gradient data, marching cubes, tetrahedral tessellation, and tracing, but do not disclose using phase data.

Claim 10 recites displaying and highlighting images where highlighting is of movement of a mechanical heart wave contraction wave. Chiang, et al. merely note use of an imaging device for pacemaker monitoring or cardiac rhythm management. There is no suggestion in Chiang, et al. or Skyba, et al. to highlight an image for movement of a mechanical heart wave contraction.

CONCLUSION:

Applicants respectfully submit that all of the pending claims are in condition for allowance and seeks early allowance thereof. If for any reason, the Examiner is unable to allow the application but believes that an interview would be helpful to resolve any issues, he is respectfully requested to call the undersigned at (650) 943-7554 or Craig Summerfield at (312) 321-4726.

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